Appendix H

2013

Dworshak Operations

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1. Introduction

The 2010 Supplemental BiOp called for specific actions at Dworshak Dam during the salmon migration to meet temperature objectives for the lower Snake River. This Appendix describes the 2013 Dworshak Dam summer operations and its affect on the lower Snake River water temperatures.

2. Dworshak Operations

The 2010 Supplemental BiOp, RPA Actions 4 and 15 call for the following Dworshak Dam specific actions. Each action is listed below in *italics* followed by the Corps' response to the actions in 2013:

<u>RPA Action 4:</u>

1. *Refill the (Dworshak) reservoir by about June 30 to 1600 feet.*

Dworshak reservoir was refilled to elevation 1600 feet on June 15, 2013. Daily inflow into Dworshak reservoir averaged about 8.1 Kcfs during the May through July 2013 time period. The peak inflows occurred much earlier this year due in part to warmer temperatures in the early months as compared with 2012 (Figure H-1).

2. *Draft the reservoir to elevation 1535 feet by the end of August and elevation 1520 feet (80 feet from full) by the end of September unless modified per the Agreement between the U.S. and the Nez Perce Tribe for water use in the Dworshak Dam.*

Dworshak reservoir was drafted to elevation 1535 feet on August 31, 2013, and drafted to elevation 1520 feet on September 21, 2013 consistent with the agreement with the Nez Perce Tribe.

3. *Regulate outflow temperatures to attempt to maintain water temperatures at Lower Granite Dam tailwater at or below the water quality standard of 68° F.*

Dworshak reservoir outflows were managed to maintain water temperatures at Lower Granite Dam tailwater below 68°F as shown on Figure H-2. The one-day maximum (68°F) daily tailwater temperature at Lower Granite Dam was exceeded a total of 6 of a possible 93 days between July 1 and September 30, 2013. The first period was between August 21 and 23 and the second period was between September 19 and 22, 2013. These occurrences were both un-avoidable. The first period of water temperature exceeding 68°F was due to the following factors:

- The volume of usable water was low due to the drier basin conditions in 2013, as compared to 2011 and 2012, when there were no water temperatures exceedances at Lower Granite tailwater greater than 68°F (Figure H-1)
- Water temperatures at Anatone was at their peak (Figure H-2), resulting in warmer inflows into Lower Granite.

- The amount of spill to provide additional water was limited as the resulting total dissolved gas levels were near the maximum.
- The air temperature and solar radiation were particularly intense resulting in higher rates of warming of stream flows.

The second period of water temperature exceeding 68°F was due to the following factors:

- Inflows had tapered off to very low levels (Figure H-1) by the end of September.
- The Elk Butte station SNOWTEL reported 83% percent of average precipitation. During September, the useful federal water supply was essentially exhausted due to the dry summer and releases in July and August.
- Higher local air temperatures contributed to warming.
- While flow tapered off significantly from Dworshak there was a corresponding increase in warmer water flowing past the Anatone gage (Figure H-2 and H-4).
- As Dworshak was drafted lower, the temperature of the water released from Dworshak became warmer by 2-4°F (Figure H-4).

When spilling during July and August, Dworshak Dam released the maximum volume of water without exceeding the 110 percent TDG Idaho state standard. The hourly augmentation flow temperatures averaged 46.4º F, with a range between 42.5º F to 47.6º F (Figures H-2, H-3). Dworshak seasonal average release temperatures during the flow augmentation season from 1999-2013 are shown on Figure H-4. At no time during the 2013 water year did the temperature exceed 69.0°F below Lower Granite. Dworshak operations were coordinated at TMT meetings seven times during June through September 2013, as shown on Table H-1. Several unscheduled conference calls were made between the actions agencies in an effort to mitigate the effects of increasing water temperatures and a dwindling supply of water available for temperature moderation.

Figure H-1
Contributing Flows into Dworshak Reservoir May to July 2012 and 2013 with Dworshak Computed June Volumes in Millions of Acre Feet 2011 to 2013

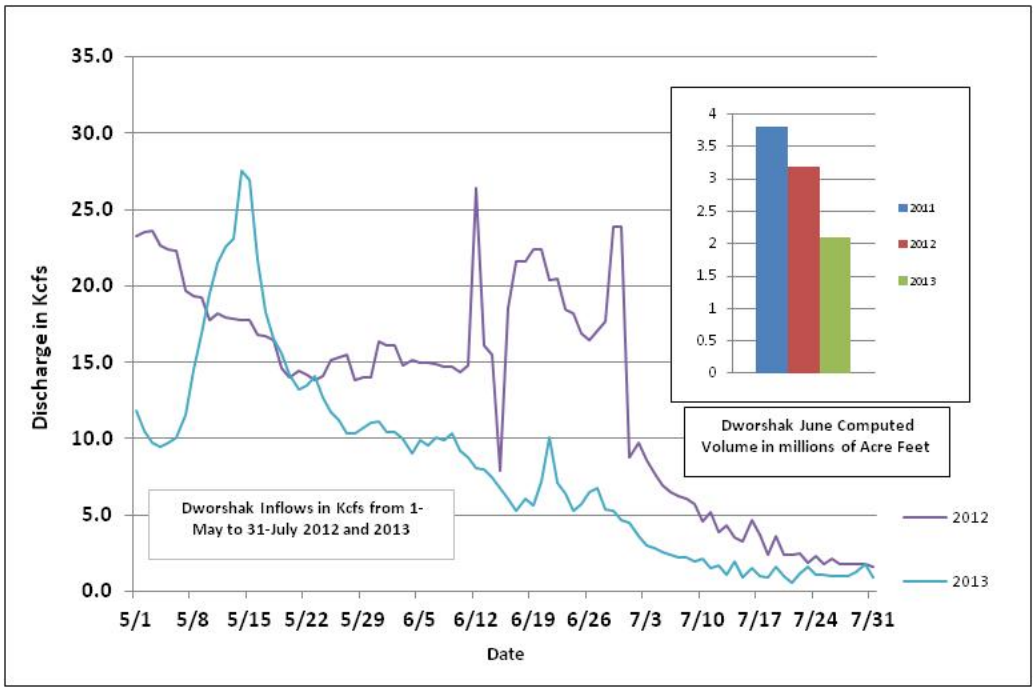

Figure H-2
Contributing Flows and Temperatures into Lower Granite
July 1 - September 30, 2013

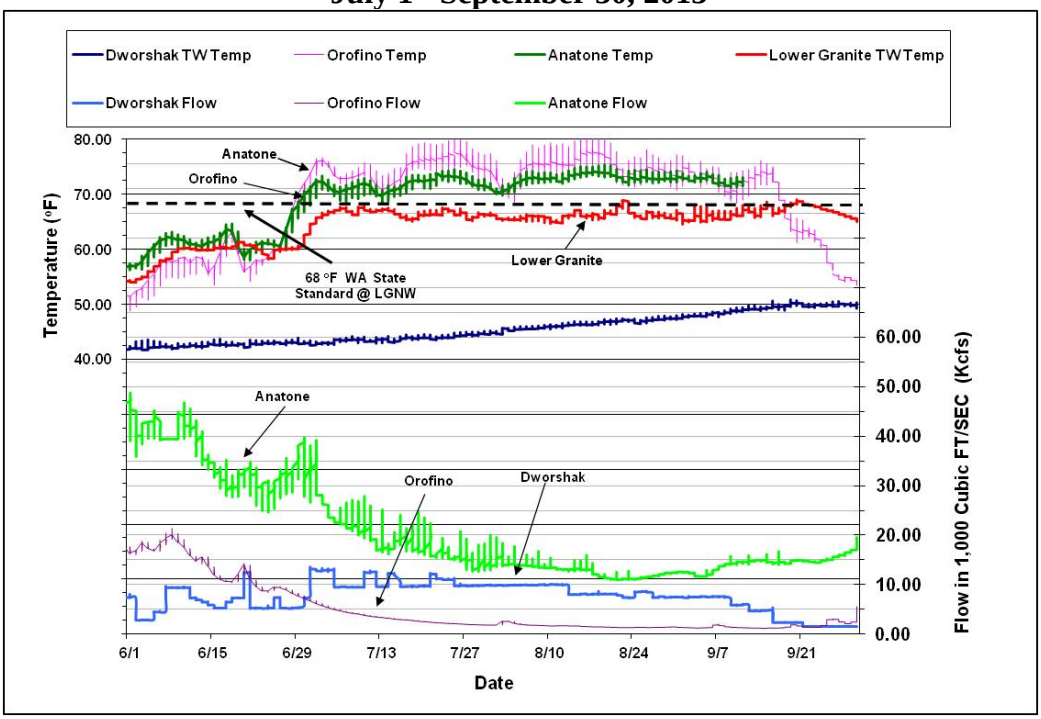

Figure H-3
Lower Granite and Dworshak Tailwater Temperatures
July 1- September 30, 2013

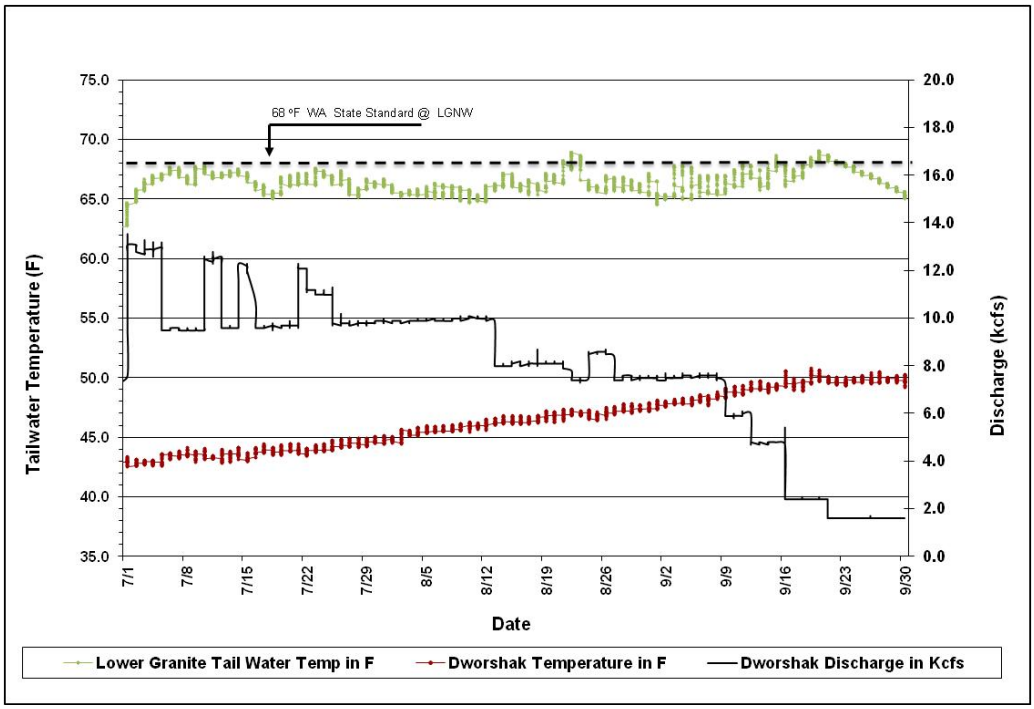

Figure H-4
Dworshak Dam Seasonal Average Release Temperature
1999-2013

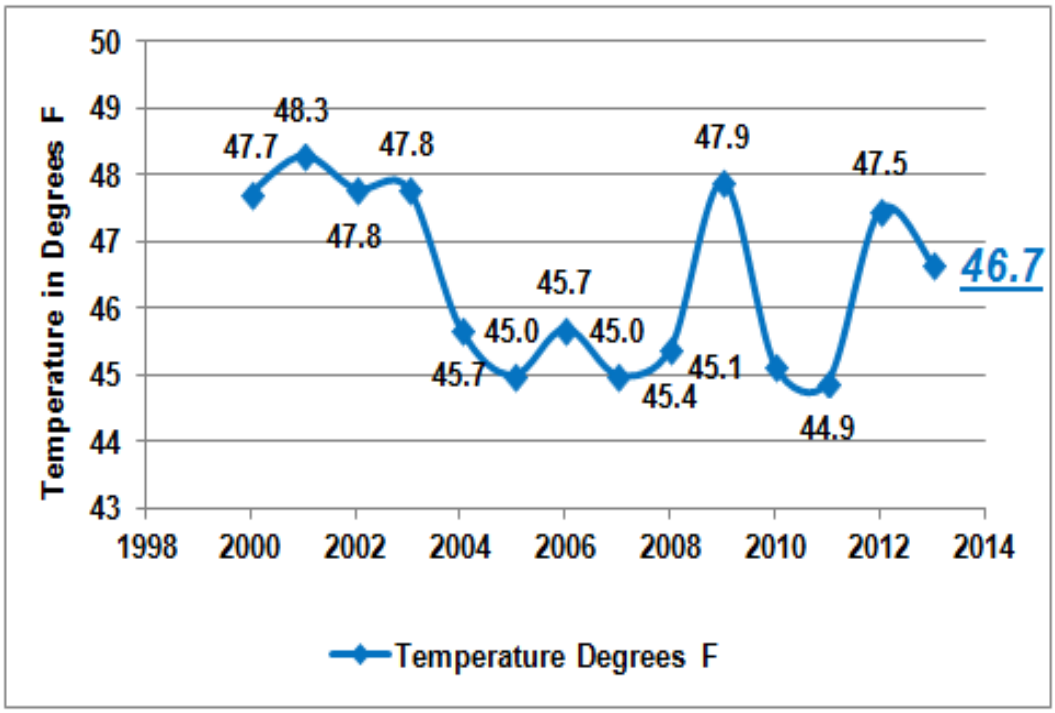

Figure H-5
Lower Snake River Temperatures
June 1- September 30, 2012

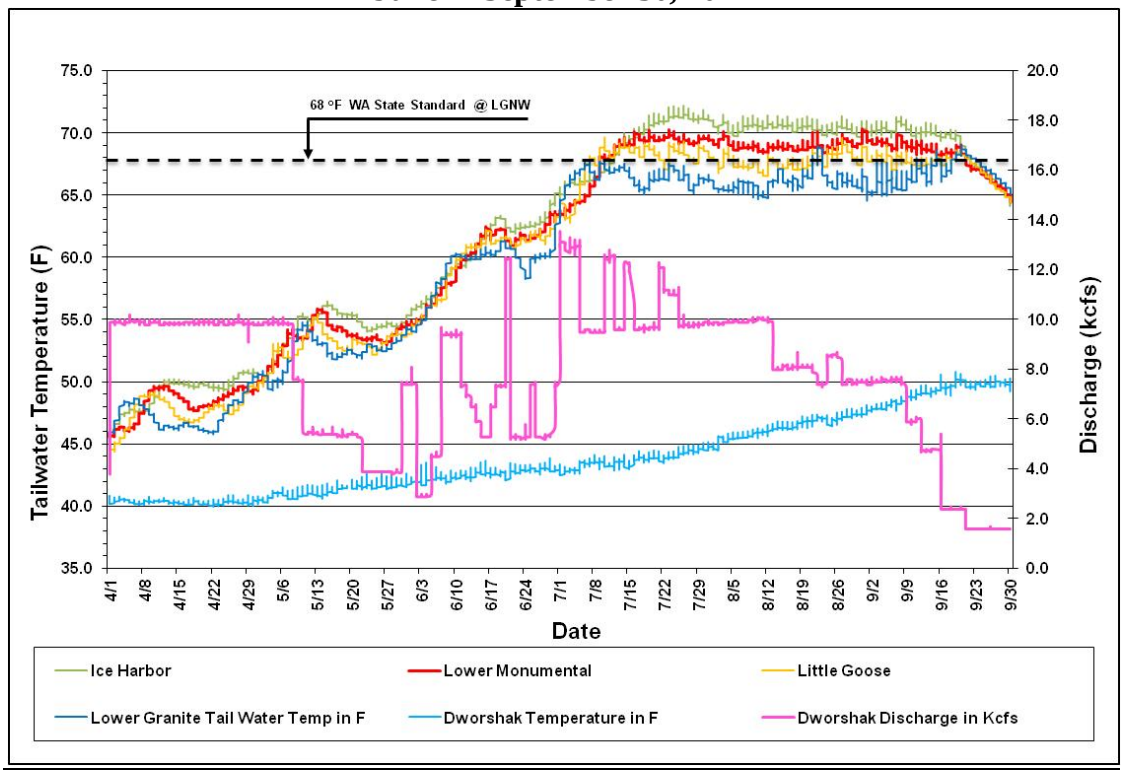

Table H-1
Dworshak Summer Operation Coordination with TMT
July 1 - September 22, 2012

TMT Meeting Date	Presented CE-QUAL-W2 Results at TMT	TMT Coordinated DWR Discharges in kcfs	TMT Coordinated DWR Discharges Temperature
6/19/2013	Yes	No Augmentation Needed	45°F
7/10/2013	Yes	9.4 +1.5	Continue45°F
7/24/2013	Yes	12.0	Continue 45°F
8/5/2013	Yes	Not Discussed	Continue 45°F
8/14/2013	Yes	8.0	Continue 45°F
8/21/2013	Yes	7.3	Continue 46°F
9/4/2013	No	Not Discussed	Not Discussed

RPA Action 15:

Continued development of the CE-QUAL-W2 model for estimating river temperatures from Dworshak Dam on the Clearwater and Upper Snake River near the confluence with the Grand Ronde River (Anatone gauge) through the four lower Snake River dams to assist in real-time decision making for Dworshak Dam operations.

The CE-QUAL-W2 model was used from June 19, 2013 to September 17, 2013 to support decisions regarding operation of Dworshak Dam for flow augmentation and temperature management on the lower Snake River. The results were presented and discussed routinely with TMT members and FCRPS Action Agencies to develop best management strategies (Table H-1).

3. Dworshak Dam Storage Project Operations Summary

In 2013, water from Dworshak reservoir was drafted to meet BiOp reservoir pool elevations and/or for temperature moderation in the lower Snake River. These operations began on July 1 and ended on September 21, when the Dworshak reservoir elevation reached 1520 ft. TMT made specific requests for temperature moderation. The request temperatures were achieved until late August and early September when there was insufficient capacity in the reservoir to fulfill the requests (Table H-1, Figure H-2, H-4). For a significant portion of the summer period Dworshak releases were driven by the 110 percent TDG Idaho water quality standard. These operations resulted in peak releases of up to of 13.5 kcfs and an average rate of 8.95 kcfs between July 1 and September 21.

4. Effects of Cold Water Releases on Lower Granite Dam Tailwater Temperatures

The daily average tailwater temperatures at Lower Granite Dam exceeded 68°F from July 1, 2013 to September 30, 2013 for six days. This was primarily due to these factors:

- Below normal snow pack and average inflows to Dworshak at 67% of last years' in-flows resulting in a tighter water supply by late summer.
- June 2013 tied with 2006 as the fifth highest average temperature on record, requiring a greater percentage of stored water to be released earlier in the augmentation season (NOAA 2013). Temperatures in August and September 2013 were approximately 1.6 °F higher than the 20th century average (NOAA 2013).
- Higher than average ambient temperatures and greater cumulative solar heating later in the summer.

Water year 2013 resulted in below average inflows to Dworshak Reservoir, similar to other tributary basins in the Snake River watershed. The watersheds above Clearwater and Middle Snake Rivers did not experience the drought conditions as severely encountered in the Southwestern United States. The average snowpack only ranged from 70 percent to 89 percent of normal in June. However, the above average ambient air temperatures during late August through mid September increased the risk of exceeding the 68°F water temperature standard.

As Figure H-3 shows, the Dworshak Dam cool water releases also reduced water temperatures in the lower Snake River reservoirs downstream from Lower Granite Dam. Although the lower Snake River water temperatures exceeded 68°F at Ice Harbor, it was still lower than it would have been without the Dworshak cool water releases.

5. Water Temperature Modeling

- Water Quality Model Improvements (2013). For monitoring season 2013, Walla Walla District automated repetitive cutting and pasting with the use scripts programmed in the "R" or "Python" language. Additional scripts automated daily data downloads required for the pre-processing. Many of the preprocessor functions became redundant and are no longer used. A total of 121 individual CE-QUAL-W2 simulations were run in 2013.

- Water Quality Model Proposed Improvements (2014). Low flows on the Clearwater River resulted in problematic surface water elevation data during late August. The NWW staff plans to update the calibration from CE-QUAL-W2, version 3.6 to version 3.7 prior to the beginning of the 2014 season. Re-calibration of the model to accept a wider range of variables is planned for winter, 2014.

6. Conclusion

Considering the factors of reduced water volume and higher average temperatures the 2013 Dworshak summer operation to moderate the lower Snake River was successful the majority of the time. For the first time in several years Lower Granite temperatures were actually exceeded in 2013. Dworshak releases greatly reduced the instances where the 68ºF water temperature standard would have been exceeded at the Lower Granite Dam tail-water monitoring station without effective use of the CE-QUAL-W2 model in support of Dworshak operational decisions.